Position on fluid mechanic
Gas turbine injection
Experiment

Post-Doc (or high level engineering) Position at University of Rouen-Normandy and CNRS CORIA, France
Liquid injection for gas turbine

Presentation:

To face the present challenges in term of efficiency and pollutant emission the new generation of gas turbine (GT) needs to be revisited and improved. The liquid fuel injection process is at the heart of the combustion system, thus the forthcoming architectures require fundamental understanding of the atomization process that occurs in realistic configuration.

A joint international initiative gathering key universities, research labs and the mains industrials actors has been set up to produce a state of the art configuration that can be studied experimentally and by numerical simulations. The present position take places in this organization with the purpose to characterize the first step of the injection process. The proposed work is mostly experimental but a strongly linked with numerical studies. Indeed, first simulations of this configuration for atomization have already been done at CORIA's lab and in collaboration with the CMT - Motores Térmicos Universitat Politècnica de València in Spain. It is also expected from the candidate to work with several industrials that follows this project in particular at SAFRAN with the purpose to prepare further studies on industrial injectors. The combustion of the injected fuel has been already characterized experimentally (Shum-Kivan et al., 2017; Verdier et al., 2018, 2017) and numerically by several groups see TCS workshops (2017 et 2019 : http://www.tcs-workshop.org/).

One conclusion of the previous studies is the importance to characterize precisely the first step of the atomization. Along the undergoing simulation of this zone, the main objective of the post-doc position is to explore experimentally the first stage of the atomization. The atomizer forms initially a liquid sheet that is stretched by the external airflow and its own swirl motion then leading to first breakup. Spatially and temporally resolved imaging technics will be the starting point of such measurements (Blaisot and Yon, 2005; Grout et al., 2013; Lounnaci et al., 2015). Further developments, of interferometry and optical methods to measure the liquid thickness and any other measurable characteristics are planned. Among them scale analysis or curvature distribution of the interface will be of interest if measureable to follow the theoretical development recently proposed at CORIA (Canu et al., 2017; Dumouchel et al., 2017).

Workplan:

- The injector test bench was set up to study combustion. Thus, the first task will be to adapt it to study initial stage of atomization and to provide a large optical access.

- Liquid issued from the injector will be characterized by using high-speed camera and adapted optical setup.
- Image analysis will be conducted to build a database for comparison with numerical simulation and theory.
- Advance optical technics by interferometry and ultrafast imagery with a femto-laser will be explored to characterize as far as possible the liquid sheet destabilization.
- Additional developments based on the initiative of the selected researcher will be considered in particular to propose a methodology to characterize the injection for industrial injector with the support of industrial exchanges.
- Since the tools developed numerically are already available at CORIA, there will be the possibility to run and post process some numerical simulations.
- All this work will be the topic of several publications.

Characteristic of the applicant

- It is expected the candidate to have a strong background on fluid mechanic that could be the result of a PhD on this field or of a strong cursus on fluid mechanic in engineering.
- Ideally, a PhD on fluid mechanics based on experimental study is expected, but a candidate with a good background on CFD willing to enlarge his experience on the experimental part will be also welcome.
- Programming post processing routines in Python will benefit of previous experiences.
- Prior knowledge on atomization or multi-phase flows (gas and liquid) will be an advantage.
- An interest on gas turbine, numerical simulation, aeronautic will be a plus.
- English at a professional level is mandatory.

Benefit for the candidate

- A strong experience on the measurement technics for flows with a complex interface morphology.
- Several experienced researchers at CORIA will be engaged on this work to provide a high-level scientific environment.
- Published several articles within a recognized scientific team.
- To build a personal network with European well-known university and industrials working on Gas Turbine.
- Understanding more the CFD part, even with the possibility to practice CFD.
- To participate to the improvement of injection system and thus to the reduction of pollutant emissions.

Administrative position

- The gross salary start from 2675 euro per month depending of the experience.
- The position can start as soon as possible in 2021 and it is planned for 18 months.
- You will be hired as an equivalent French engineer or researcher with all social advantages.
- Please note that for security reason and for visa there is an administrative delay. This delay can be up two months, thus early applications will be considered first.

Contact

The main advisor to contact is:

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Bibliography

Blaisot, J.B., Yon, J., 2005. Droplet size and morphology characterization for dense sprays by image processing: application to the Diesel spray. Exp. Fluids V39, 977–994.

Canu, R., Dumouchel, C., Duret, B., Essadki, M., Massot, M., Ménard, T., Puggelli, S., Reveillon, J., Demoulin, F.-X., 2017. Where does the drop size distribution come from?, in: Proceedings ILASS–Europe 2017. 28th Conference on Liquid Atomization and Spray Systems. Presented at the ILASS2017 - 28th European Conference on Liquid Atomization and Spray Systems, Universitat Politècnica València. https://doi.org/10.4995/ILASS2017.2017.4706

Dumouchel, C., Aniszewski, W., Vu, T.-T., Ménard, T., 2017. Multi-scale analysis of simulated capillary instability. Int. J. Multiph. Flow 92, 181–192. https://doi.org/10.1016/j.ijmultiphaseflow.2017.03.012

Grout, S., Blaisot, J.-B., Pajot, K., Osbat, G., 2013. Experimental investigation on the injection of an urea–water solution in hot air stream for the SCR application: Evaporation and spray/wall interaction. Fuel 106, 166–177. https://doi.org/10.1016/j.fuel.2012.09.022

Lounnaci, K., Idlahcen, S., Sedarsky, D., Roze, C., Blaisot, J.-B., Demoulin, F.-X., 2015. Image processing techniques for velocity, intereface complecity, and droplet production measurement in the near-nozzle region of a Diesel spray 25, 753–775.

Shum-Kivan, F., Marrero Santiago, J., Verdier, A., Riber, E., Renou, B., Cabot, G., Cuenot, B., 2017. Experimental and numerical analysis of a turbulent spray flame structure. Proc. Combust. Inst. 36, 2567–2575. https://doi.org/10.1016/j.proci.2016.06.039

Verdier, A., Marrero Santiago, J., Vandel, A., Godard, G., Cabot, G., Renou, B., 2018. Local extinction mechanisms analysis of spray jet flame using high speed diagnostics. Combust. Flame 193, 440–452. https://doi.org/10.1016/j.combustflame.2018.03.032

Verdier, A., Marrero Santiago, J., Vandel, A., Saengkaew, S., Cabot, G., Grehan, G., Renou, B., 2017. Experimental study of local flame structures and fuel droplet properties of a spray jet flame. Proc. Combust. Inst. 36, 2595–2602. https://doi.org/10.1016/j.proci.2016.07.016